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NEW FACTS
CONCERNING THE ETIOLOGY
OF HOG CHOLERA.

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NEW FACTS CONCERNING THE ETIOLOGY OF HOG CHOLERA.^a

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PRELIMINARY REMARKS.

During the course of the investigations concerning hog cholera which have been carried on by the Biochemic Division of the Bureau of Animal Industry, certain outbreaks of that disease were met with which apparently were not produced by the hog-cholera or the swine-plague bacilli. The disease was highly contagious and fatal to a large proportion of the hogs which were attacked. These observations, which were inexplicable previous to the researches herein recorded, together with the great variations in the physical symptoms and the postmortem lesions encountered in different outbreaks of so-called "hog cholera," have led us to institute experiments to determine, if possible, whether or not there are other infectious diseases among hogs in this country than those caused by the hog-cholera and swine-plague bacilli, and also to ascertain what was the etiological agent in those outbreaks of disease mentioned above, which apparently did not depend upon these bacilli for their existence. These experiments have not yet been completed, but have gone far enough to enable us to publish this preliminary information.

The outbreaks of disease which have furnished material for the study of the questions just outlined have all had their origin in southwestern Iowa, but, owing to the great distance of that point from Washington and the fact that it was not possible to establish a satisfactory laboratory in the field, it has been found necessary to expose a certain number of animals to infection in Iowa and then transport them by express to the Bureau Experiment Station near this city, where all the inoculations were made by the superintendent of the station. After once bringing the disease to Washington no trouble was, as a rule, experienced in perpetuating it by transferring from one animal to another.

The experiments have reached such a stage that we feel justified in stating that there is an infectious disease among hogs in this country which can not be distinguished clinically from hog cholera, and which may be reproduced by infecting with material which contains no hog-

^a The article in the main is published as Circulars Nos. 41 and 43 of this Bureau.

cholera bacilli. It will be understood that at this time no estimate can be made as to the frequency with which this disease occurs, nor as to its distribution throughout the country.

Below is presented a brief outline of the facts which have been established in regard to this disease.

ETIOLOGY.

Nothing can be stated at present as to the cause of this disease. It has been demonstrated, however, that the primary cause is neither the hog-cholera bacillus nor the swine-plague bacillus. We have transferred the disease repeatedly from one hog to another by subcutaneous inoculation of certain body fluids, these fluids being always proved, by careful bacteriological examinations, by filtration through the finest porcelain filters, and by the inoculation of guinea pigs and rabbits, to be free from hog-cholera and swine-plague bacilli. We have used a system of checks upon the various inoculation experiments by means of which we have been able to exclude all chance of accidental pen infection or of infection through the syringes.

The disease is highly contagious, healthy pigs that were allowed to come in contact with sick animals almost invariably becoming sick within the usual period of incubation. So far we have been unable to communicate this disease to any other animal than hogs. Rabbits and guinea pigs are entirely insusceptible to inoculations that are of sufficient size to destroy pigs weighing from 30 to 40 pounds.

SYMPTOMS.

The period of incubation after exposure to sick animals, or after a subcutaneous inoculation of infectious material from sick animals, varies from five to twelve days, the usual time elapsing between exposure and visible signs of illness being seven days. The first symptoms noticed are that the pig is slightly indisposed; there is loss of appetite and listlessness, but, as a rule, nothing else on the first day. By the second day of visible illness the animal is usually very sick, hollow in flanks, and has a staggering gait. There may or may not be diarrhea, and the feces are frequently blood-stained. Almost without exception the eyes are sore and the lids glued together. The symptoms just enumerated become gradually more pronounced until the death of the animal, which takes place, as a rule, within seven days after the appearance of the initial symptoms and approximately two weeks after the first exposure to infection.

It must be explained that the experimental pigs which we have used weighed from 15 to 40 pounds, and it is possible that in the case of older and larger animals the period of incubation and the course of the disease may be of longer duration. This point, together with many others, is left for future determination.

POSTMORTEM APPEARANCES.

The skin over the abdomen may be reddened throughout, or these cutaneous lesions may appear as more discrete purpuric areas of varying size. Upon removing the skin of the thorax and abdomen the subcutaneous areolar tissue is generally found to be thickly dotted with small ecchymoses. There is usually not the slightest evidence of inflammation at the point of inoculation if the animal has been injected subcutaneously.

LYMPHATIC SYSTEM.

The inguinal glands on both sides are reddened, as are the lumbar, retroperitoneal, mesocolic, mesenteric, and bronchial glands. The reddening of these glands varies in intensity; at times the hemorrhagic condition is slight, while at others it is so intense that practically all of the glands are deep red, approaching black in color.

DIGESTIVE SYSTEM.

(a) *Stomach.* There may be considerable congestion and inflammation of the mucosa and also small hemorrhages on the serous surface. (b) *The small intestines* usually present a large number of small ecchymoses on their serous surfaces and not infrequently the mucous surface is in the same condition. (c) *Cecum and colon.* This portion of the intestines, almost without exception, shows hemorrhagic areas on its serous and mucous surfaces, these hemorrhages being, as a rule, fewer in number and larger in extent than those seen in the small intestines. In the cecum and ascending colon it is not unusual to find large numbers of small newly formed ulcers which occasionally show a hemorrhagic center. (d) In several instances there has been a most severe hemorrhagic inflammation of the *rectum* extending throughout its entire length. The intestinal contents are not infrequently blood-stained. (e) *Liver.* This organ is usually mottled, and may exhibit diffuse grayish areas which appear to be due to an increase of connective tissue. Small ecchymoses and areas of necrosis are not infrequently seen on the surface of the organ. The histological examination of this organ has not been completed.

LUNGS.

The lungs frequently show hemorrhagic areas on their surface, but, as compared with the other organs, are usually slightly affected.

HEART.

Hemorrhagic areas are occasionally seen on the surface of the auricles and ventricles.

SPLEEN.

The spleen is always enlarged, dark in color, and not infrequently shows small petechiae on its under surface.

KIDNEYS.

The kidneys are always the seat of hemorrhagic changes, which vary in extent. At times the whole organ is intensely congested, all the glomeruli being visible as minute, deep-red points, while at others it is as a whole not congested, but exhibits in its cortex a number of small, sharply defined, very dark hemorrhagic spots.

From the above-described lesions and symptoms it will be seen that this disease is apparently identical in all particulars with the acute type of hog cholera, and that it is produced without the aid of the hog-cholera bacillus.

The fact that this particular type of hemorrhagic hog cholera is so similar in both symptoms and lesions to the ordinary acute hog cholera supposed to be caused by the hog-cholera bacillus, and that, by our methods of inoculation, without the presence of the hog-cholera bacillus, we have never produced a case of *chronic* hog cholera, have led us to suspect that possibly in *all* outbreaks of *acute* hog cholera there is some other agent besides the hog-cholera bacillus at work, and that in those cases of acute disease where the hog-cholera bacillus is found we have to do, not with a pure infection, but with a mixed infection by hog-cholera bacilli and the organisms which are responsible for the disease which we have just described. In fact, virulent hog-cholera bacilli have been isolated from hogs in which the disease had been produced by inoculation with infective material in which the absence of the bacilli had been proved by filtration, by cultures, and by the inoculation of rabbits or guinea pigs.

If such supposition is well founded, it is quite evident what an important bearing it must have upon the prevention and treatment of hog cholera, and we hope to be able to decide this point positively when the experiments now under way shall have been completed.

Sufficient work has been done to show that this particular form of hog cholera may be prevented by those measures which have been found to be effective in dealing with the ordinary forms of that disease—the isolation of sick animals and disinfection of all infected lots with carbolic acid and lime being sufficient to prevent a spread of the disease.

METHODS OF PRODUCING IMMUNITY.

As experiments in this line and also in methods of producing immunity from this disease have been in progress for some years, it seems that, in view of the results, the important points of the investigations should be published, so that the State experiment stations and others, if they so desire, may make experiments on a large scale along the lines of work which have proved most successful.

On account of the often discordant results which were secured some years ago when the Bureau was treating diseased hogs with serum from

animals which in their turn had received large and repeated doses of hog-cholera and swine-plague cultures, it appeared that some other factor must be considered in the efforts to produce immunity. The first suggestion of de Schweinitz was that some parasite of the hog, such as the louse, should be studied. This was carefully done, but the results obtained were such as to make it appear that, while a louse might under certain conditions convey disease from a sick to a healthy animal, it was not the important agent in spreading so-called hog cholera.

A large number of specimens of blood from sick and healthy hogs were also examined and, while very small, peculiar, round bodies were found both inside and outside of the corpuscle, and sometimes bodies with distinct ameboid movement were noted, the relation, if any existed, of these bodies to the disease could not be determined satisfactorily. It was noted, however, that in cases of so-called hog cholera the disease could be readily conveyed from a sick animal to a healthy one by giving the latter a subcutaneous injection of the blood serum or defibrinated blood obtained from the former. It was found that a small fraction of a cubic centimeter would produce the disease though we have in most of our experiments fixed 1 cubic centimeter as the most satisfactory dose for use. As has been indicated above, blood from a diseased animal which was passed through the fine Berkefeld or Chamberland filter produced in hogs the typical disease. This blood had been proved to be free from microorganisms detectable by the ordinary bacteriological methods or by the inoculation of small animals, such as the guinea pig or rabbit, which are known to be very susceptible to the ordinary hog-cholera bacillus. It appeared, therefore, that immunity could be produced by the use of blood in which the disease-producing property had been attenuated or partially neutralized. The experiments have well established the fact, which is also true of the so-called hog cholera, that animals once immunized against this disease will resist repeated large doses of disease-producing blood and also subsequent exposure to diseased hogs in the field.

The basis of the immunity experiments, therefore, has been the use of attenuated and disease-producing liquid or dried blood, or the use of this blood mixed with blood obtained from immune animals, in which animals the immunity has been increased by the injection of large doses of disease-producing blood obtained from hogs known to have the disease; or, in other words, disease-producing blood and antitoxic blood separate and combined have been successfully used.

In order to test the immunity of the treated animals, they were either exposed by inoculating them with known disease-producing blood or by placing them in the field or pen with sick animals.

The previous work of this Bureau has shown very clearly that animals immune from hog cholera are not necessarily immune from swine

plague, or vice versa, and, furthermore, that many different diseases may at times be mistaken for hog cholera. In making practical exposure tests, therefore, it is absolutely necessary to prove the character of the disease by careful autopsies and by the use of a large number of checks, which checks should succumb to the disease in order to prove the positive virulence of the exposure.

Although we are still trying the experiments on a large scale and shall continue them during the coming summer before recommending the details of a plan for practical adoption, we feel that these results of the extensive and laborious experiments which have been carried on by the Bureau for a number of years should be presented now in this concrete form, as it will require a number of months to prepare the detailed reports of the experiments for publication.

The writers have had charge of the general plan of this work and proposed the use of blood from diseased and immunized animals. The practical inoculations and autopsies at the Experiment Station of the Bureau have been carried out under the supervision of Dr. E. C. Schroeder, who also made, at the request of the Chief of the Bureau, some immunity experiments with dried diseased blood. The work in Iowa has been in charge of Dr. W. B. Niles.

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